

APIC 3

## Computer Hardware Basics

Computer is more than just a processor or screen; it is an integrated system whose components collaborate to execute complex analytical workflows.

### Central Processing Unit (CPU)

The CPU is the "brain" of the computer. It actually executes instructions organized into programs (software) that determine the computer's actions.

#### Role in Biostatistics

- Executes statistical algorithms, such as regression, survival analysis, and Bayesian inference.
- Enables simulations for epidemiological modeling and clinical trial scenario projections.

#### Role in financial Engineering

- Runs high-speed option pricing models, Monte Carlo simulations, and algorithmic trading strategies.
- Determines execution latency in high-frequency trading (HFT) systems.

#### Technical insight

- Multi-core CPUs enable parallel computation of independent simulations (e.g., bootstrap resampling or Monte Carlo iterations).
- Vectorized instructions (SIMD) accelerate linear algebra operations in large cohort



or portfolio datasets.

### Memory (RAM)

Random Access Memory (RAM) is fast, volatile, and relatively expensive. It temporarily stores:

- Active programs.
- Data currently processed.
- Intermediate results.

### Analytical Relevance

• Biostatistics: Holding Large patient datasets or Multi-dimensional Matrices during Computation-intensive Survival or Longitudinal analyses.

Financial Engineering: Storing Large Covariance Matrices, time, Series data and intermediate stages in stochastic simulations.

### Key Consideration

Insufficient RAM Causes disk swapping, which drastically slows Computations in both health and financial simulations.

### Mass Storage Devices

• Mass storage refers to slower, long-term memory that retains data between computational jobs.

#### Examples:

- Hard Disk Drives (HDDs).
- Solid-State Drives (SSDs)
- Optical Discs (Archival).

## Input Devices

Input devices deliver data and instructions into the system.

### Analytical Examples:

- Biostatistics: Clinical trial data, Lab Measurements, Survey inputs.
- Financial Engineering: Market data feeds, Simulation Parameters, scenario.

### Modern Considerations:

Input increasingly arrives via digital pipelines

- APIs.
- Networked Sensors.
- Electronic Data Capture(EDC) systems.

## Output Devices

Output devices - Monitors, Printers, dashboards -  
Visualize Computational results.

### Domain Examples:

Biostatistics: Kaplan-Meier Plots, epidemic Curves, gene expression heatmaps.

Financial Engineering: VAR reports, risk dashboards, real-time analytics.

### Analytical Insight:

Clear output is essential for interpreting multi-dimensional datasets or model diagnostics.

## EX 1

This code measures how computer architecture affects analytical performance.

it benchmarks CPU speed using parallel Monte Carlo Simulation, RAM efficiency using a Large Matrix operation, and storage performance through disk read/write tests. It prints these results and visualizes all three timings with annotated, color-coded subplots in one row script [1].